A STUDY IN APHASIA.[1]

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THE study of aphasia has been developed along two distinctly diverging lines. German authors, and chief among them Wernicke and Lichtheim, have built up what we might call diagrammatic theories of speech, neglecting largely the relation that speech bears to the other faculties of mind. English writers, such as Jackson and Bastian, have dwelt upon the psychology of language and have troubled themselves far less with the relegation of speech to actual and definite cortical areas and the tracts connecting them. During the last few years the writings of various authors, particularly of Freud, Sachs, Wyllie and Dejerine, have shown the necessity of harmonizing and uniting the conclusions of the two principal methods of research employed in the study of language.

In his text-book on the Nervous Diseases of Children, Dr. Sachs, in speaking of aphasia, makes the following statement:

" Although the diagrammatic representation of language as perfected by Wernicke and Lichtheim has done much toward an understanding of aphasia, the close adherence to diagrams has prevented an appreciation of the psychic processes of language. The psychological point of view as developed by Jackson and Bastian and recently adopted by Freud, will, in connection with Wernicke's localization theories, lead to a better knowledge of the subject." In concluding his critical remarks the author expresses the belief "that in further studies on aphasia the strictly anatomical and the psychological theories must be blended with one another or must, at least, be allowed to supplement each other."

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[1] Read before the New York Neurological Society, Oct. 6, 1896.

A correct interpretation of the anatomical findings can, indeed, only be expected if the case was understood from a psychological point of view. It is interesting to note in this respect that cases which by some authors (Broadbent, Mills, etc.) had been explained by lesions of a special "naming-centre," have been found to belong to the group of optic aphasias, being due to an interruption of the association tracts, existing between the object representations and the auditory-speech images. A clinical observation, unsupported by an autopsy, may, in fact, occasionally be of more value than a post-mortem examination with a history incomplete from a purely clinical or psychological point of view.

In reporting the following case of (cortical) motor aphasia, with the kind permission of Dr. Sachs, I have been guided by the above considerations; I have endeavored to study the conditions as thoroughly as possible, to discover the mutual dependence of the symptoms upon each other and to give each of them its correct interpretation. This can only be done by discussing the mental processes underlying the acquisition and full development of the faculties of speech, reading and writing, and by demonstrating the intimate connection and manner of cooperation of the various cortical apparatus which the nature of these processes necessitates[2]

History.—Mrs. S. D., aged 23, born in the United States, of Irish parentage. Three years ago had acute articular rheumatism and during that attack probably acquired her present heart trouble, an insufficiency and stenosis of the mitral valve. No other attacks of rheumatism since that time. Married two and a half years ago. During the first year of married life suffered an abortion in the third month of pregnancy. June 7, 1895, delivered of a child at full term. Aweek later had an apopletic attack due evidently to embolism, the etiology of which must be sought for in the disease of the mitral valve. When the general effects of the lesion had passed off, the patient presented hemiplegia of the right side, with involvement chiefly of the right arm, especially of the hand and fingers. There was further complete motor aphasia and alexia, probably also complete agraphia, although on this point the patient can give no definite information. The patient claims that the understanding of spoken language was fully unimpaired; but this statement must be taken with due reserve. About two and a half months after onset, began to regain speech a little; the first words she could say were: "Yes, I want to go home." Then the speech became more fluent until she spoke as she does now (April 1896). Only about a month ago, that is, in March, 1896, she began to be able to read some.

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[2] Dr. Sachs has kindly supplied me with much of the literature upon the subject. His valuable criticisms in reading over the manuscript of this paper, have induced me to modify some of my views, partly also to change the form of the paper. I take occasion here to express my gratitude for his kindness.

The paper was practically finished before I had read Dr. Wyllie's treatise on the disorders of speech, Dr. Elder's article (Notes on Aphasia with Special Reference to a Subdivision of Broca's Convolution) and the classical researches made in Dr. Dejerine's Clinic and Laboratory. My conclusions, particularly regarding the "internal language" and the important part which the motor-speech centre plays in the functions of reading and writing, were therefore reached quite independently of these authors, being based partly upon general psychological argumentation and partly upon a careful study of the case in question. It was a great satisfaction to find that some of my deductions were strongly supported by the ample clinical evidence which Dejerine and his pupils have brought forward, and that my views coincided in many points with those of Wyllie and Elder whose nomenclature I partly adopted when revising this paper.

The patient was first seen on April 3, 1896, and was examined several times during the said month. At that time the following condition was found to be present:

Rather anaemic woman. Examination of the heart reveals marked insufficiency and stenosis of the mitral valve. The patient presents a hemiplegia of the right side.

Right upper extremity paralyzed in a high degree. Extreme contractions of fingers and in elbow. No motion of fingers except very slight movement of little finger; no flexion of wrist possible and extension just noticeable. No pronation or supination to speak of. Flexion of elbow to a limited extent and inability to fully extend the forearm at the elbow. Abduction of arm and other movements in shoulder joint very limited.

Sense of pain slightly diminished in right arm; sense of touch normal.

Lower extremities.—In walking drags the right leg, which also shows distinct spasticity. Right knee-jerk exaggerated, left normal. No sensory disturbances in the lower extremities.

Functions of the auditory nerves and ocular nerves and muscles normal. Pupils normal.

Facial innervation in repose and on making voluntary movements is normal, but when smiling, the right nasal fold is less marked and the right corner of the mouth hangs a little lower than the left.

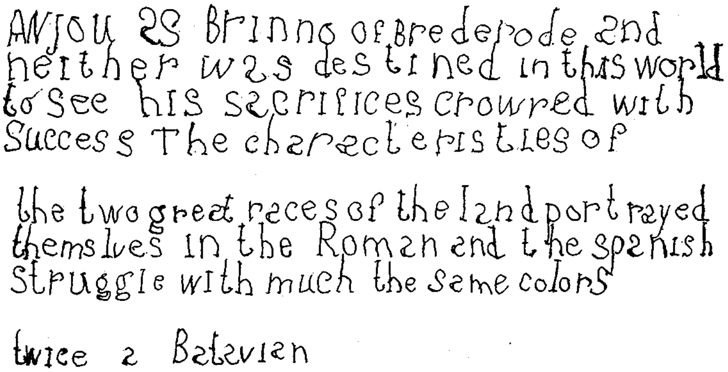
Vision. $\frac{10}{10}$ in both eyes. No narrowing of visual fields. No hemianopsia.

Speech, Reading and Writing.—The patient shows only slight disturbance of motor speech, consisting in some slight difficulty of finding the words, especially when speaking for some length of time, and manifesting itself further by occasional misuse in the proper construction of sentences.

Occasionally a question has to be repeated before she understands its meaning, otherwise the understanding of spoken language seems unimpaired. There is, however, some difficulty of naming objects presented. It is true that most of these are promptly named, but it proves that, for instance, she does not know the designation of a portrait, nor of a photograph, nor of an oil painting, as all three kinds of objects are called "pictures," and the patient is absolutely unable to find the individual names, "photograph, portrait, painting," although she must certainly have been familiar with at least the first two of these before the apopleptic seizure. It is even doubtful whether she actually recognizes the essential difference between these various kinds of "picture." Aside from these disturbances there was marked defect of the faculty of reading and writing. The patient recognizes many of the individual letters of the alphabet with great difficulty, while some are at first not recognized at all,or are mistaken for other letters. The reading of whole words is also impaired, but not proportionately to the faculty of reading the letters composing them. It is found that the patient reads many a word fluently and yet frequently spells it with great difficulty or wrongly. Occasionally she omits letters. On the whole, it is easier for her to read a word in toto than to read the letters composing it. Sometimes she reads a word wrongly and then, although looking at it, spells it in accordance with the mistake made; for instance, the word "the" is read two and spelled t, w,o. It can be at times distinctly proven, that the patient does not spell the words by looking at each single letter, but from the sound of the word after she has read the latter. This is shown from the fact that she reads "one" correctly, but spells it "w, o, n,"which has the same sound. Another example is "unknown" which she reads correctly, but spells u, n,w, n, o, w, n,.

Written text is read worse than printed, a fact which needs no explanation, since this is also the case under normal conditions

COPY.



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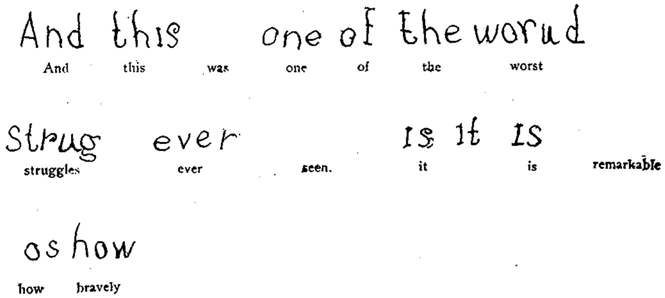

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The above reproductions of the patient's handwriting illustrate her peculiarity of using printed signs instead of script in writing.

In writing, which is done with the left hand, the patient uses printed signs instead of written ones, both in copying and in writing to dictation. Copying is done slowly and nearly mechanically. Writing to dictation causes much more difficulty than reading; the patient writes much slower and makes many more mistakes than she does in reading; sometimes she begins to write a word correctly, but fails to finish it or completes it incorrectly. One has the distinct impression in such a case, that she has forgotten the word before she has finished writing it.

The understanding of read text seems to be entirely proportionate to her faculty of reading; that is, as soon as she has read all words composing a not too long sentence, she as a rule readily grasps the meaning of this sentence; but if the reading of individual words of a sentence causes much strain, the difficulty of deciphering the words make her lose connection between them; she has forgotten the first words while reading the last. There is no doubt, that the auditory impressions received from loud reading help the understanding and enable her to decipher words a posteriori, which she had not been able to decipher before. That is she sometimes fails to read a word or misreads it, but recognizes her mistake as soon as she has read the words following it.

In some respects the examination had to remain incomplete, as the patient was lost sight of. I may emphasize this however, that she had absolutely no visual disturbances. Vision $\frac{10}{10}$ in both eyes. No hemianopsia. No narrowing of the visual fields. Entirely normal perception of colors.

The memory was not carefuly tested. The intention to do so was frustrated by the non-appearance of the patient; but the fact alone that she made a rapid progress in the faculty of reading during the sessions devoted to the test of this faculty, indicates the absence of gross lesions of memory. It seems appropriate here also to make some remarks on the patient's mental attainments. The patient had been a clerk in a dry goods store. Her duty was to show goods to the customers and to write out orders for the goods bought. This tends to show that she had considerable practice in writing, as in the rush of business, the writing had to be done rather hurriedly. Aside from such routine writing she did some correspondence, writing about one or two letters a week to friends. On the whole, however, she did much more reading than writing, and read for the most part from printed text, chiefly from novels and the like. She had acquired the faculty of reading, by means of the old method of learning first the single letters and then the reading of words by spelling. Her education corresponded to that of a girl passing through the upper grades of a grammar school.

Before entering upon a discussion of the symptoms in the case reported I wish to refer to some recent investigations which may help to enlighten us on the nature and function of that part of the brain which heretofore has been designated as the motor-speech centre. I shall first mention the researches of Bianchi.[3] which, although not bearing directly upon this question, may yet serve to throw some light on it in an indirect way.

Bianchi has recently studied the effects of the removal of the frontal lobes in monkeys and has arrived at the following conclusions regarding the functions of this part of the brain:

The frontal lobes preside over certain higher mental faculties and are, so to say, a centre for the intelligence. They constitute the organ in which the various sensory and motor images deposited in the different centres of the cortex become coordinated and fused. The destruction of this region entails the loss of the anatomical and physiological basis upon which judgment and the reasoning faculties are reared. These defects were very evident in monkeys deprived of both frontal lobes.

The anatomical results greatly harmonize with the conclusions to which the author had been led by study of the mental condition of such animals. Bianchi found hardly any degenerated fibres in the internal capsule of a monkey whose frontal lobes had been removed and who was allowed to live eleven months after the operation. He concludes from these observations that the frontal lobe contains but a very small number of projection fibres. He found, however, extensive degeneration in other regions, showing that the frontal lobe possesses a vast associative corona radiata, the fibres of which distribute themselves to the motor district and to the sensory areas. The association with the occipital lobe is established chiefly by means of the fasciculus occipito-frontalis, the connection with the temporal lobe principally by means of the capsula externa, possibly, also, of the capsula extrema and of the fasciculus uncinatus, while the association with the central convulutions occurs partly by means of the fasciculus arcuatus.

So far Bianchi. It remains to show in how much the observations of this author can contribute to the elucidation of the physiology and psychology of articulate speech. The experiments upon animals cannot, of course, give us any information on the function and position of the speech centres. But in accepting Bianchi's theory the following question should be answered: Shall we consider Broca's centre as part of the frontal lobe in the sense of Bianchi's definition of this organ or shall we count it among the motor areas of the cortex?

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[3] Bianchi: Annali di Nevrologia, 1895, p. 149.

Until recently Broca's centre has commonly been considered as motor. One has spoken of motor word images or motor memories of speech, in contrast to auditory word memories. The anatomical position of this so-called "motor-speech centre" would, indeed, not contradict such a view, since it is directly contiguous with that area of the cortex which we are accustomed to call the motor district and might, therefore, be considered as a part of it. But, on the other hand, the function of Broca's centre is so much more complex than that of the parts composing the motor district proper that we hesitate to put it on one line with these. From the result of recent observations we further become more and more convinced that, while the cortex of the motor district is directly connected with the gray masses of the cerebral axis, the connection of the so-called motor-speech centre with these gray masses is indirect, being interrupted by cells of other regions of the cortex. It seems to be very probable that the fibres emanating from Broca's centre find their ending place in that division of the cortex where the centres for the larynx, pharynx, tongue and the lower part of the face are situated, and that a second neuron is needed to establish the connection with the nuclei of the pons and medulla. If such is the case we must conclude that Broca's centre is a centre of a higher order, presiding over the centres of the larynx, pharynx, tongue and the lower part of the face. It will then remain to demonstrate that it not only presides over the motor centres mentioned, but has at the same time the function of fusion of sensory and motor elements, and must, consequently, be considered as a part of the frontal lobe in the sense of Bianchi's definition.

In advancing such a hypothesis I wish to point out that it greatly harmonizes with the view which Wyllie[4] expresses on this subject. In his excellent book on the disorders of speech we meet the following statement: "It seems to me that the foot of the third frontal convolution is not motor in function and yet has relations of extreme importance to the motor production of speech; we are almost forced to the conclusion that it must be in a special manner the storehouse of the psychological pictures or memories which in themselves are so largely sensory in constitution, being made up chiefly from memories of muscular and tactile sensations."

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[4] Wyllie: The Disorders of Speech. Edinburgh, 1894.

The assertion that the motor-speech centre is a centre of a higher order presiding over the centres of the larynx, pharynx, etc., finds further support in Elder's[5] observation. This author had the opportunity to perform the autopsy on a case with the following history [given in abstract]:

In a man of sixty, always well and strong before, speech suddenly became affected. The next day one could notice paresis of the right side of the face, not involving the orbicularis palpebrarum, however. He spoke in a thick and very blurred manner so that it was difficult for him to pronounce the words distinctly. This, however, was seen to be due simply to a difficulty he had in moving the tongue, lips and other muscles of articulation as readily as he wished to. There was no real aphasia, he knew what he was going to say, tried to say it and always succeeded in saying it, but the words were blurred and indistinct. Difficulty in swallowing. The voice unimpaired in every respect. No paralysis of the arms or legs. Five days afterwards he grew weaker, showed signs of hypostatic congestion in the base of the lungs, and died the next day.

The autopsy report of this case reads as follows:

On slicing the brain horizontally a blood clot of about a dessertspoonful in quantity was found at the level of the lower part of the ascending frontal and ascending parietal convolutions of the left hemisphere (see Fig. 1). It had destroyed almost entirely the cortical substance of the lower end of these convolutions, from the Sylvian fissure as high up as the level of the fissure that divides the second from the third frontal convolution. It left intact the third frontal convolution and that region of the lower part of the ascending frontal which adjoins the precentral sulcus.

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[5] Elder: Edinburgh Hospital Reports, 1895, p. 463.

The findings of the case induce Elder to substantiate Wyllie's view and to subdivide Broca's convolution [in the old sense of the term] in the following manner (see Fig. 2):

(a) Centre of the psycho-motor images of speech, occupying the foot of the third frontal convolution between the precentral sulcus and the anterior ascending branch of the Sylvian fissure.

(b) Centre for the adduction of the vocal cord or phonation centre—which was intact in Elder's case—occupying the anterior part of the lower end of the ascending frontal convolution, that is, the area adjoining the centre of the "psycho-motor images."

(c and d) The articulo-motor centre—nearly entirely destroyed in Elder's case—occupying the lower part of the ascending parietal convolutions with the exception of the area occupied by the centre (phonation).

(g) Probably there is also a respiratory centre near by, the action of which is required in speaking.

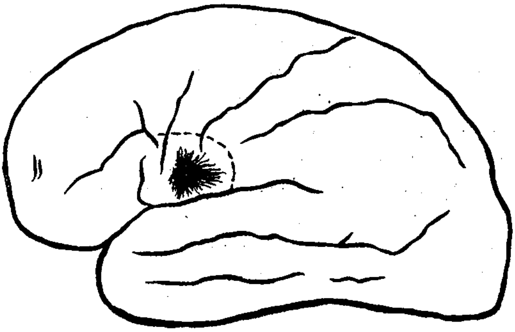

Fig. I.—Position of focus in a case which had presented dysarthritic but no aphasic symptoms (Elder).

In accepting this subdivision and in assuming that the centre of the psycho-motor images is associated with the three (or two?) sub-centres mentioned, the creation of the type of subcortical motor aphasia (Wernicke) or aphasie motrice pure (Dejerine) finds its justification and would be produced by an interruption of the said association tract, which presumably is contained within the fasciculus

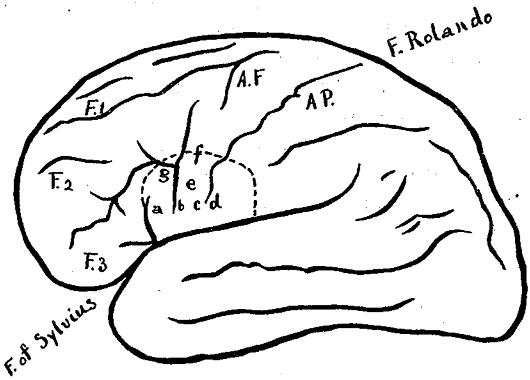

Fig. II.—Subdivision of Broca's convolution after Elder.
a. Psycho-motor speech area or centre of the psycho-motor images of speech (Wyllie).
b. Centre for the adduction of the vocal cords (phonation centre).
c. and d. articulo-motor centre (centre for the muscles of the tongue, throat and opening and closing of mouth—Horsley and Beevor).
e. Centre for the lower face and angle of mouth (Horsley and Beevor).
f. Centre for upper part of face (Horsley and Beevor).
g. Centre for acceleration of respiratory movements of the larynx.

arcuatus. H. Sachs[8] also inclines towards this view. Dejerine[7] finds subcortical motor aphasia due to destruction of the projection bundles of the third frontal convolution, which practically means the same thing, as by such destruction the connection of the centre of the "psycho-motor" images of speech with the sub-centres of Broca's area must also become interrupted.

With the acceptance of Wernicke's old theory of the existence of a special "speech tract" (Sprach-bahn) connecting the motor-speech centre [that is, the centre of the psycho-motor images] directly with the nuclei of the medulla, a pure type of subcortical motor aphasia could not be conceived, as it could not be imagined without the coexistence of anarthritic or dysarthritic disturbances. Wernicke[8] has finally given up this theory, and it is only strange that he clung to it so long.

Whenever in the further course of this paper the terms

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[6] H. Sachs: Vorträge über den Bau und die Thätigkeit des Grosshirns und die Lehre von der Aphasie und Seelenblindheit. Edition of 1893.

[7] Quoted from Mirallié: L'aphasie sensorielle, p. 101.

[8] According to a quotation of H. Sachs, l. c.

" motor-speech centre " or " Broca's centre " or " Broca's area," are used, it is meant to designate by these terms only that part of Broca's convolution which Wyllie and Elder call the centre of the psychomotor images of speech. This distinction will be desirable, as only lesions of the centre of the psychomotor images should produce lesions of the mental or " internal language "—and, accordingly, alexia and agraphia, as will be shown later on—while lesions of Elder's " subcentres of Broca's convolution should cause only the impossibility or disturbance of articulate or external speech, leaving the so-called internal or mental language intact and, consequently, not causing any disorders of the faculties of writing and of mental reading.

(To be continued.)